Version 1.06

User Manual

Event Study Metrics

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May 30, 2014

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Installing Event Study Metrics

Event Study Metrics is either distributed on a single DVD-ROM or as a download version. Before you start the installation process, close all other applications.

To install Event Study Metrics from a DVD-ROM, simply insert the disk into the drive. If the setup does not begin automatically, you will need to run ***Setup.exe*** from the disk's root directory.

For either method, you might need administrator privileges. The installation of the software is straightforward. You are advised to read the terms of the license before proceeding with the installation. Thereafter, you can specify the directory you wish to install your copy of Event Study Metrics. By default, Event Study Metrics will install to:
\program files\event study metrics

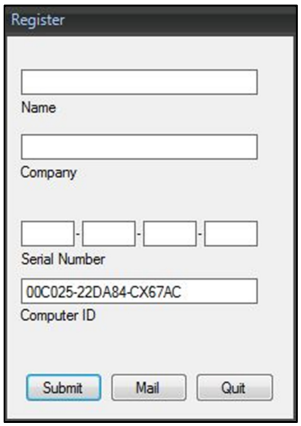
Once the installation process is complete, you can launch Event Study Metrics with a double click on the Event Study Metrics icon on the start menu.

	2 GHz processor (dual core or more recommended)
Minimum	1024 MB RAM, 50 MB free hard drive space
System	Windows XP (SP2 or above), Windows Vista, Windows 7/8
Requirements	.NET Framework 3.5 SP1 (or higher)
	1280 x 800 pixel display

Registering Event Study Metrics

The first time you run Event Study Metrics on your computer, you must register the program using the serial number printed on your license form. The registration is a one-time process of assigning a serial number to a specific computer and validating the license.

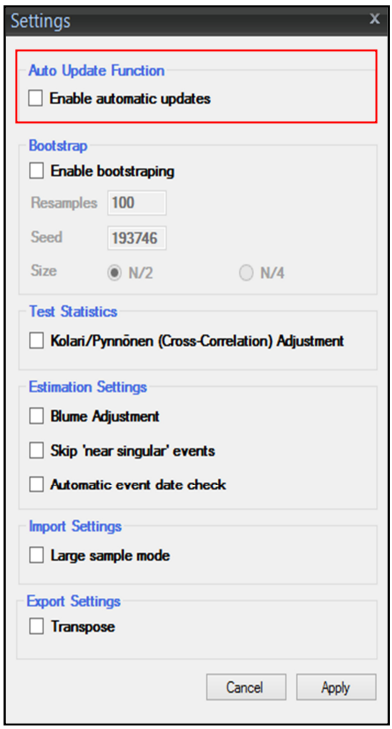
If the copy of Event Study Metrics is not registered, the program will automatically display a registration form.



You must fill in your name and the serial number, giving a company name is optional. If you are connected to the Internet, you can automatically validate your license by clicking on ***Submit***. The option to register your product manually is recommended if you do not have an internet connection. You can display the information for manual registration by clicking on ***Mail***.

Updating Event Study Metrics

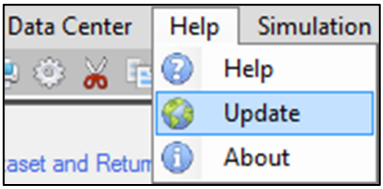
Event Study Metrics provides an automatic update feature that checks for new updates. Whenever a new update is available, the program will display a message and offer the opportunity to install the latest version. You can enable/disable the automatic updates feature in the **Auto Update Function** section of the ***Settings*** form:



You can either select the ***Settings Form*** feature from the ***Edit menu***, or you can simply click on the ***Settings Form*** icon.

Updating Event Study Metrics

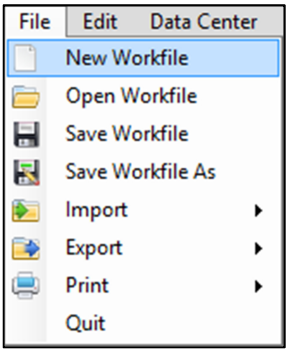
You may manually check for updates by selecting ***Update*** from the ***Help*** menu:



The Event Study Metrics Workfile

The Event Study Metrics Workfile offers you the possibility to store and load the raw data, settings and results of your analysis into a single file.

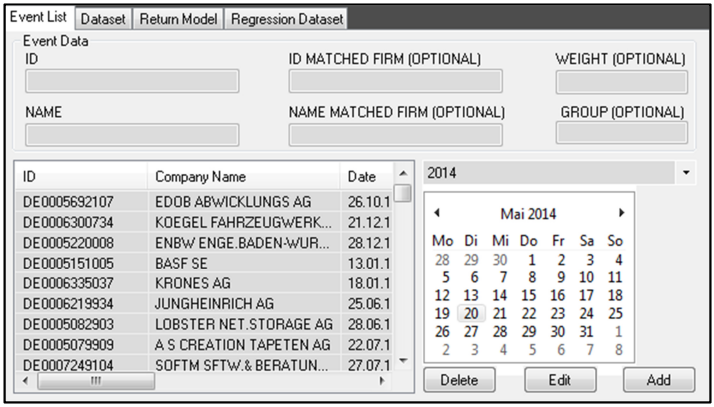
To create and setup up a new Event Study Metrics Workfile you can either select the ***New Workfile*** feature from the ***File menu***, or you can simply click on the ***New Workfile*** icon:



Click on the **Save** icon to save a copy of your Event Study Metrics Workfile on your hard disk drive. Alternatively, you can select the **Save *Workfile/Save Workfile As*** feature from the ***File*** menu.

Event List

The ***Event List*** is the single tool to manage the sample of your research project independent of the type of study you may plan to conduct. At a minimum, you must enter an asset identifier ***ID***, a company name, and an event date.



The ***Date*** is the event date on which the event study is centered. Each ***Date*** should be a trading day that occurs in your ***Dataset***. Otherwise, Event Study Metrics will display an error message. You may use the ***Event Date Check*** function from the ***Edit menu*** to check the validity of your event dates.

The ***ID*** is used to match a unique security to each event. You are free to choose any format (e.g. ISIN, CUSIP) as long as the ***ID*** of the ***Event List*** corresponds to the security identifiers of your ***Dataset.***

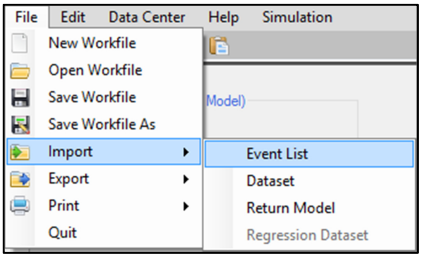
Option: You can specify a ***Matched Firm***. This allows you to apply the matched firms (portfolio) approach to estimate CARs and BHARs.

Event List

Option: You can add a ***Weight*** to each event to apply an individual weighting scheme to your event study.

Option: You can match each event to a specific ***Group***. This allows you to create subsamples out of your overall sample, e.g. if you want to analyze CARs for different groups.

The ***Import -> Event List*** feature from the ***File*** menu provides a simple way to import a sample from a comma-separated value file (.csv). Most spreadsheet or database programs allow you to store your data as a comma-separated value file (.csv).



Any comma-separated value file (.csv) must satisfy the following requirements:

- There is one event per line and the values are separated by a unique delimiter that can be chosen in the import dialogue within the Event Study Metrics software.

- The first line contains the column headings.

Event List

- The column order of the comma-separated value file (.csv) should be identical with the column order of ***Event List:*** *1st* ***ID,*** *2nd* ***company name,*** *3rd* ***date,*** *4th* ***ID matched firm,*** *5th* ***company name matched firm,*** *6th* ***Weight,*** *7th* ***Group***. **Items 4 to 7 are optional items.**

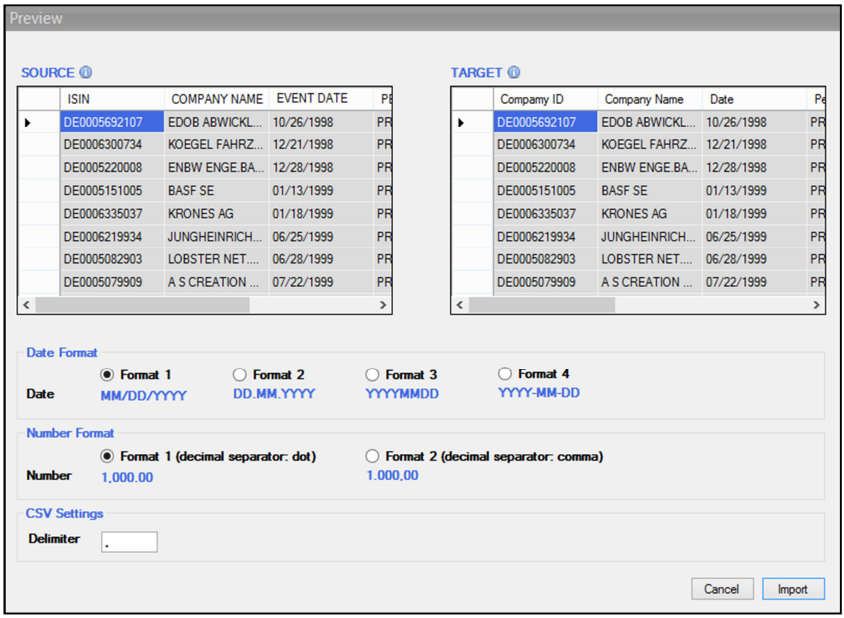
  Example: Your event list should only contain items 1 to 3 and the **Group** item. In that case your comma separated value file (.csv) needs to be organized as follows: 1st column **ID**, 2nd ***company name,*** *3rd* ***date,*** 4th to 6th column ' blank', 7th ***Group.***

- The date format should correspond to one of the formats available in the import dialogue within the Event Study Metrics software. You are able to select among **four** most common date formats: *MM/DD/YYYY* (***format 1***), *DD.MM.YYYY* (***format 2***), *YYYYMMDD* (***format 3***), or *YYYY-MM-DD* (***format 4***).

- A valid number is either of the form 1,000**.**00 (***format 1***) or 1.000**,**00 (***format 2***) that can be chosen in the import dialogue within the Event Study Metrics software.

Event List

*Note: The **Preview** window (**Source**) in the import dialogue shows you how your original data is formatted. This allows you to check whether your data and the chosen settings in the import dialogue are correct. Once the data has been imported, the Event Study Metrics software will convert all datasets into a unitary format (the **Date Format 1** and the **Number Format 1**). The **Preview** window (**Target**) in the import dialogue shows you how your data is ultimately formatted and used with the Event Study Metrics software.*



Event List

Note: If at least one of the comma-separated value file (.csv) preferences differs from the preferences selected in the import dialogue, the software will display an error message that will provide you with the specific error description. An additional explanation of the error codes is provided in the appendix of this document.

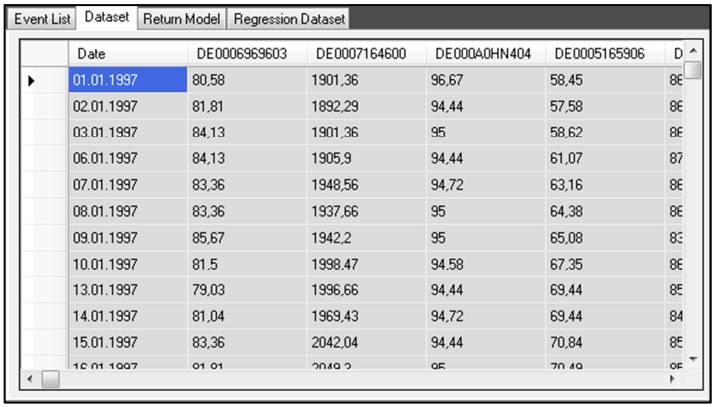
*An error message will also occur if an invalid preferences combination (e.g. the **Date Format 1**, the **Number Format 2**, and a **comma** (**,**) as the **Delimiter**) is chosen in the import dialogue.*

- A **detailed manual** on how to set up an **Event List** based on a "comma-separated value file" (.csv) can be found here: http://eventstudymetrics.com/wp-content/uploads/2014/02/ESM-IMPORT-Event-List-CSV-manual-1.06.pdf

- A **sample file** can be found here: http://eventstudymetrics.com/wp-content/uploads/2014/06/Events.csv

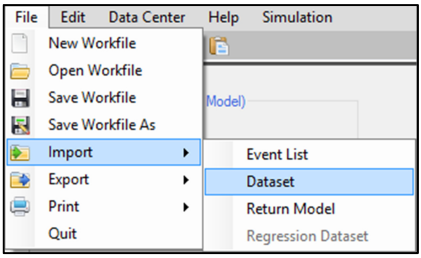
Dataset

The ***Dataset*** spreadsheet contains the asset pricing data of all sample firms.



Date	DE0006969603	DE0007164600	DE000A0HN404	DE0005165906	D
01.01.1997	80,58	1901,36	96,67	58,45	8E
02.01.1997	81,81	1892,29	94,44	57,58	8E
03.01.1997	84,13	1901,36	95	58,62	8E
06.01.1997	84,13	1905,9	94,44	61,07	87
07.01.1997	83,36	1948,56	94,72	63,16	8E
08.01.1997	83,36	1937,66	95	64,38	8E
09.01.1997	85,67	1942,2	95	65,08	83
10.01.1997	81.5	1998.47	94.58	67.35	8E
13.01.1997	79,03	1996,66	94,44	69,44	8E
14.01.1997	81,04	1969,43	94,72	69,44	84
15.01.1997	83,36	2042,04	94,44	70,84	8E

The ***Import -> Dataset*** feature from the ***File*** menu provides a simple way to import a sample from a comma-separated value (.csv) file created by any spreadsheet or database program:

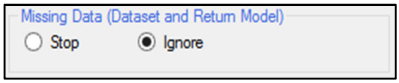


Your comma-separated value (.csv) file can contain the asset pricing data of all sample firms. Each column should exhibit a time series for an asset over the full sample period. You must denote missing values by *NA* or

Dataset

N/A. The first column should contain the trading dates of the sample period.

You do not need to specify the treatment of missing values when importing your data, but you may do so before conducting your study by selecting an option from the ***Missing Data*** section:



These options have the following consequences in case necessary return data (i.e. observations within the estimation or event window) is missing: choosing

- "Stop" will abort the current estimation and an error message is displayed.

- "Ignore" will keep the asset, but the missing data point(s) (i.e. single- or multi-day return(s)) will be ignored. Estimates will be based on the remaining return data. Test statistics will be adjusted accordingly.

You can either import a dataset based on price data or return data. You must specify the type of data in the ***Raw Data*** section:

Dataset

If your dataset is relatively large (more than 50 MB) you might want to use the option **large sample mode** on the ***Settings*** form. In this mode the dataset is not displayed in the respective spreadsheet to obtain results much faster and bind less memory resources.

Any comma-separated value (.csv) file must satisfy the following requirements:

- Each line contains observations of a single point in time and the values are separated by a unique delimiter that can be chosen in the import dialogue within the Event Study Metrics software.

Option: If you want to apply the matched firms (portfolios) approach, your dataset must contain the asset pricing data of all **Matched Firms**.

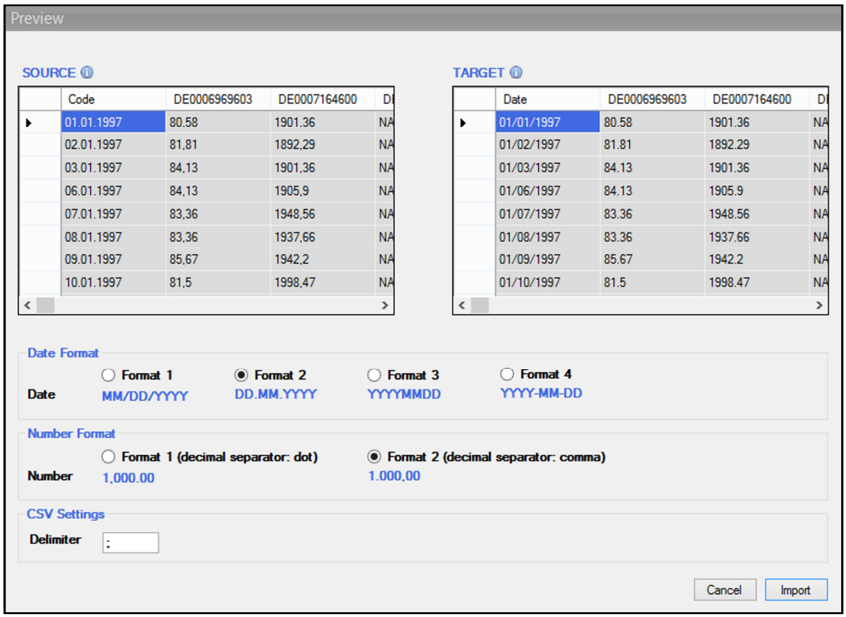
- The first line contains the column headings (security identifiers).

- The date format should correspond to one of the formats available in the import dialogue within the Event Study Metrics software. You are able to select among **four** most common date formats: *MM/DD/YYYY* (***format 1***), *DD.MM.YYYY* (***format 2***), *YYYYMMDD* (***format 3***), or *YYYY-MM-DD* (***format 4***).

- A valid number is either of the form 1,000**.**00 (***format 1***) or 1.000**,**00 (***format 2***) that can be chosen in the import dialogue within the Event Study Metrics software.

Dataset

*Note: The **Preview** window (**Source**) in the import dialogue shows you how your original data is formatted. This allows you to check whether your data and the chosen settings in the import dialogue are correct. Once the data has been imported, the Event Study Metrics software will convert all datasets into a unitary format (the **Date Format 1** and the **Number Format 1**). The **Preview** window (**Target**) in the import dialogue shows you how your data is ultimately formatted and used with the Event Study Metrics software.*



Dataset

Note: If at least one of the comma-separated value file (.csv) preferences differs from the preferences selected in the import dialogue, the software will display an error message that will provide you with the specific error description. An additional explanation of the error codes is provided in appendix of this document.

*An error message will also occur if an invalid preferences combination (e.g. the **Date Format 1**, the **Number Format 2**, and a **comma** (**,**) as the **Delimiter**) is chosen in the import dialogue.*

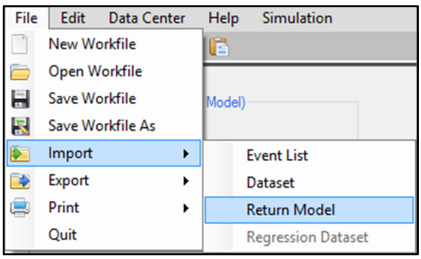
- A **detailed manual** on how to set up a **Dataset** based on a "comma-separated value file" (.csv) can be found here: http://eventstudymetrics.com/wp-content/uploads/2014/07/ESM-IMPORT-Dataset-CSV-manual.pdf

- A **sample file** can be found here: http://eventstudymetrics.com/wp-content/uploads/2014/06/Dataset.csv

Return Model

Depending on the type of study you plan to conduct, you can choose between different options for modeling the normal (i.e. expected) return. If you want to implement the market model, market adjusted return, the CAPM, or a multifactor model, you need to add the corresponding data to the ***Return Model*** spreadsheet.

The ***Import -> Return Model*** feature from the ***File*** menu provides a simple way to import a sample from a comma-separated value file (.csv) created by any spreadsheet or database program:



At least, your comma-separated value file (.csv) must contain the time series of your market index. The time series can either consist of index values, or it can consist of return data. You must specify the type of data in the ***Raw Data*** section (see ***Dataset).***

If your model is defined by excess returns, the second column must contain the corresponding interest rate. You must not use annualized rates, but rather rates that coincide with your individual data frequency.

Return Model

The following columns can carry up to four factors. If you plan to implement a factor model, all data must be defined in terms of returns instead of prices. Additionally, you must select the return option in the ***Raw Data*** section.

Any comma-separated value file (.csv) must satisfy the following requirements:

- Each line contains observations of a single point in time and the values are separated by a unique delimiter that can be chosen in the import dialogue within the Event Study Metrics software.

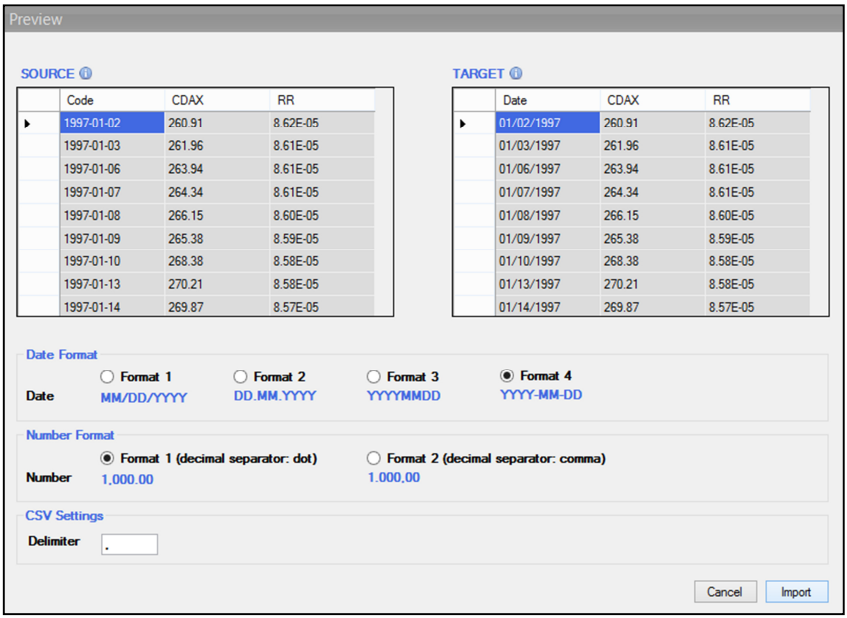
- The first line contains the column headings.

- The date format should correspond to one of the formats available in the import dialogue within the Event Study Metrics software. You are able to select among **four** most common date formats: *MM/DD/YYYY* (***format 1***), *DD.MM.YYYY* (***format 2***), *YYYYMMDD* (***format 3***), or *YYYY-MM-DD* (***format 4***).

- A valid number is either of the form 1,000**.**00 (***format 1***) or 1.000**,**00 (***format 2***) that can be chosen in the import dialogue within the Event Study Metrics software.

Return Model

*Note: The **Preview** window (**Source**) in the import dialogue shows you how your original data is formatted. This allows you to check whether your data and the chosen settings in the import dialogue are correct. Once the data has been imported, the Event Study Metrics software will convert all datasets into a unitary format (the **Date Format 1** and the **Number Format 1**). The **Preview** window (**Target**) in the import dialogue shows you how your data is ultimately formatted and used with the Event Study Metrics software.*



Return Model

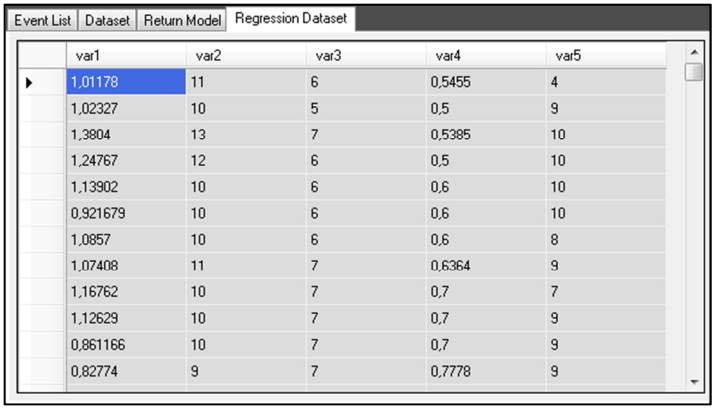
Note: If at least one of the comma-separated value file (.csv) preferences differs from the preferences selected in the import dialogue, the software will display an error message that will provide you with the specific error description. An additional explanation of the error codes is provided in appendix of this document.

*An error message will also occur if an invalid preferences combination (e.g. the **Date Format 1**, the **Number Format 2**, and a **comma** (**,**) as the **Delimiter**) is chosen in the import dialogue.*

- A **detailed manual** on how to set up a **Return Model** based on a "comma-separated value file" (.csv) can be found here: http://eventstudymetrics.com/wp-content/uploads/2014/02/ESM-IMPORT-Return-Model-CSV-manual-1.06.pdf

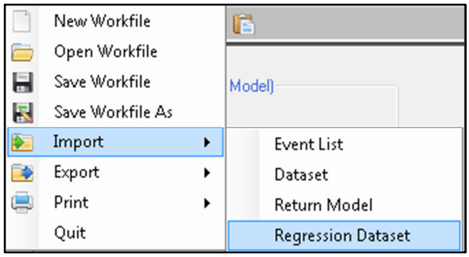
Regression Dataset (Event Study Metrics Plus)

The ***Regression Dataset*** spreadsheet contains the observations for different variables in your dataset.



	var1	var2	var3	var4	var5
▸	1,01178	11	6	0,5455	4
	1,02327	10	5	0,5	9
	1,3804	13	7	0,5385	10
	1,24767	12	6	0,5	10
	1,13902	10	6	0,6	10
	0,921679	10	6	0,6	10
	1,0857	10	6	0,6	8
	1,07408	11	7	0,6364	9
	1,16762	10	7	0,7	7
	1,12629	10	7	0,7	9
	0,861166	10	7	0,7	9
	0,82774	9	7	0,7778	9

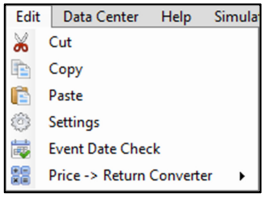
The ***Import -> Regression Dataset*** feature from the ***File*** menu provides a simple way to import a sample from a comma-separated value (.csv) file created by any spreadsheet or database program:



The software automatically denotes missing values by *NA*.

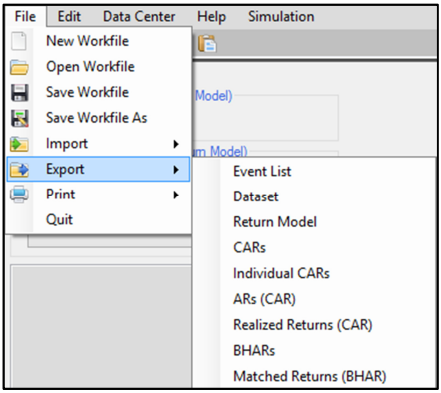
Export Data

To use the data of your Event Study Metrics Workfile in any other program you can simply copy & paste the data from any arbitrary spreadsheet. You can change the sort order of most spreadsheets by simply clicking on the desired column heading.



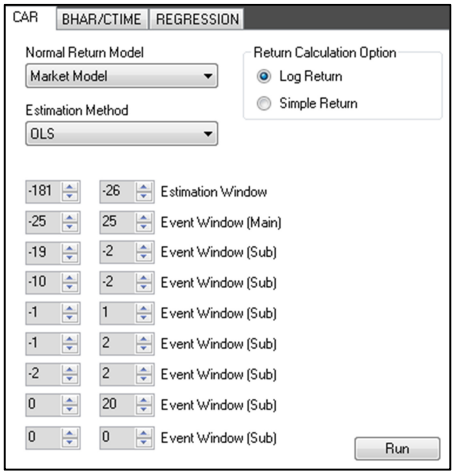
Furthermore, you can transpose your dataset while exporting by choosing the **Transpose** option on the ***Settings*** form. This can be helpful in case you want to open a large dataset in a spreadsheet program which only has a limited amount of columns.

Additionally, the ***Export*** feature from the ***File*** menu provides a simple way to export a complete spreadsheet of your results to a comma-separated value file (.csv).



The 'CAR' Method

A common method to analyze abnormal performance around a single event is the application of the cumulative abnormal return measure. Event Study Metrics offers a powerful and simple implementation of this method. All necessary controls are located in the ***CAR*** menu. For a detailed discussion of this method you may refer to Campbell, Lo and MacKinlay (1997), and the appendix of this document.



The ***Event Window (Main)*** defines the period over which a possible influence of the event on the asset involved should be examined. When applying a typical event study, it is common to take account of multiple sub periods prior, during, and following the event. Event Study Metrics offers the simultaneous consideration of different sub periods that can be defined in ***Event Window (Sub)***.

The ***Estimation Window*** defines the period used to estimate the ***Normal Return Model's*** parameters where applicable.

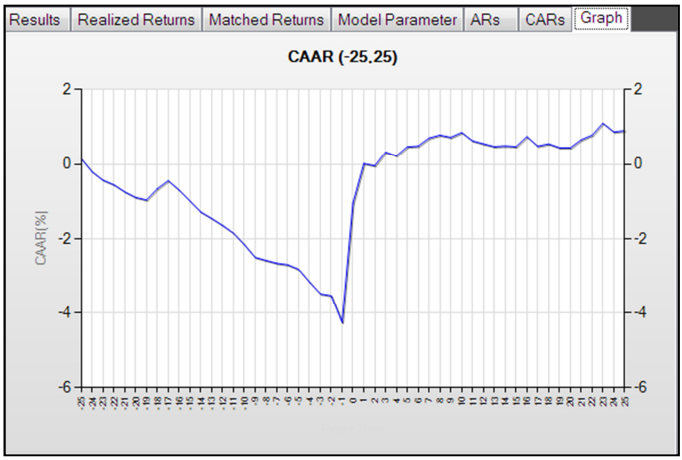
The 'CAR' Method

The start and the end of each time window are defined relative to the event date (*event time*). To specify the start and the end of each window, you can directly type in these values or use the up/down buttons. Event Study Metrics prohibits any overlap of the ***Estimation Window*** and the ***Event Window***.

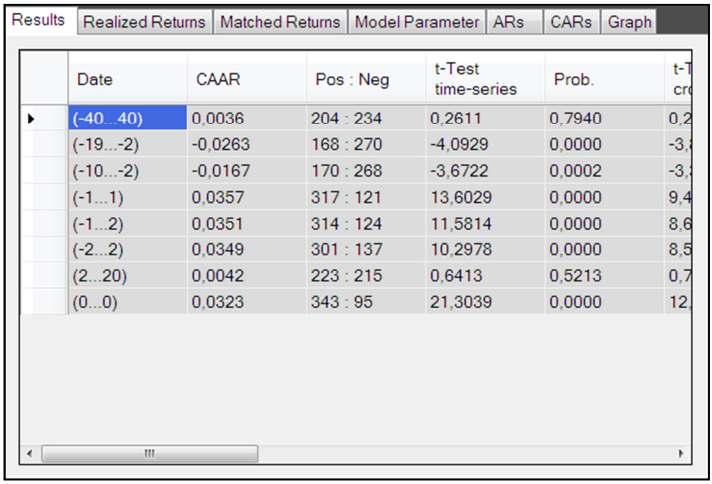
Numerous approaches to estimate the normal return of a given asset have evolved since researchers have started conducting event studies. The most common models and estimation techniques are available in Event Study Metrics. You might select a particular model from the **Normal Return Model** menu. Where applicable, you can select an appropriate regression technique from the ***Estimation Method*** menu.

Once all selections have been made, you can execute the event study analysis by clicking on the ***Run*** button. Depending on the sample size the execution can take up to several minutes. The window might freeze while the program is in execution mode, but will be accessible after all calculations have been made.

The ‘CAR’ Method



The summarized results, intermediate calculation and sorting steps, and a graph are shown in the ***Results*** section**.**



Date	CAAR	Pos : Neg	t-Test time-series	Prob.	t-T cr
(-40...40)	0,0036	204 : 234	0,2611	0,7940	0,2
(-19...-2)	-0,0263	168 : 270	-4,0929	0,0000	-3,
(-10...-2)	-0,0167	170 : 268	-3,6722	0,0002	-3,
(-1...1)	0,0357	317 : 121	13,6029	0,0000	9,4
(-1...2)	0,0351	314 : 124	11,5814	0,0000	8,6
(-2...2)	0,0349	301 : 137	10,2978	0,0000	8,5
(2...20)	0,0042	223 : 215	0,6413	0,5213	0,7
(0...0)	0,0323	343 : 95	21,3039	0,0000	12,

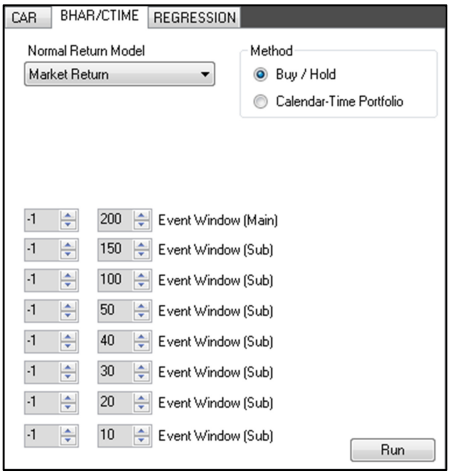
The ‘CAR’ Method

The ***Print*** feature from the ***File*** menu provides a simple way to print a summary report containing a table of summary statistics and a graph showing cumulative abnormal returns over the event window.

To use the results in any other program you can simply copy & paste the data from any arbitrary spreadsheet or use the ***Export*** feature from the ***File*** menu.

The 'BHAR' Method

A common method to analyze the long-term abnormal performance around a single event is the application of the buy-and-hold abnormal return measure. Event Study Metrics offers a powerful and simple implementation of this method. All necessary controls are located at the ***BHAR/CTIME*** menu. For a detailed discussion of this method you may refer to Lyon, Barber and Tsai (1999), and the appendix of this document.



To start with your analysis, you might select the ***Buy / Hold*** option from the ***Method*** menu.

The ***Event Window (Main)*** defines the period over which a possible influence of the event on the asset involved should be examined. Applying a typical event study, it is common to take account of multiple sub periods prior, during, and following the event. Event Study Metrics offers the simultaneous consideration of different sub periods that can be defined in ***Event Window (Sub)***. The start and the end of each window are defined relative to the event date (*event time*).

The 'BHAR' Method

To specify the start and the end of each window, you can directly type in these values or use the up/down buttons.

The two most common approaches (matched firms (portfolios), market return) to estimate the normal return of a given asset are available in Event Study Metrics. You may select a particular model from the **Normal Return Model** menu.

By default, the cross-sectional average of buy-and-hold abnormal returns is calculated based on an equal weighting scheme. You may employ a value-weighted average by checking the **Use Weights** option in the ***Raw Data*** section. Event Study Metrics then calculates a value-weighted average based on your own weights as specified in the ***Event List***.

Once all selections have been made, you can execute the event study analysis by clicking on the ***Run*** button. Depending on the sample size the execution can take up to several minutes. The window might freeze while the program is in execution mode, but will be accessible after all calculations have been made.

The summarized results, intermediate calculation and sorting steps, and a graph are shown in the ***Results*** section.

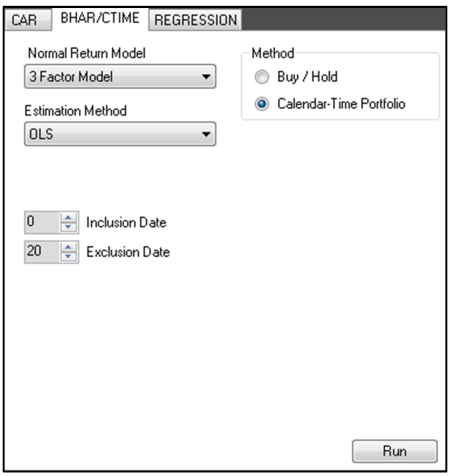
The ***Print*** feature from the ***File*** menu provides a simple way to print a summary report containing a table of summary statistics and a graph showing buy-and-hold abnormal returns over the event window.

The ‘BHAR’ Method

To use the results in any other program you can simply copy & paste the data from any arbitrary spreadsheet or use the ***Export*** feature from the ***File*** menu.

The 'Calendar-Time Portfolio' Method

The Calendar-Time Portfolio method allows you to assess if event firms persistently earn abnormal returns. The general idea is to form a portfolio of event firms and to test if this portfolio exhibits any abnormal return not captured by common risk factors. Event Study Metrics offers a powerful and simple implementation of this method. All necessary controls are located at the ***BHAR/CTIME*** menu. For a detailed discussion of this method you may refer to Lyon, Barber and Tsai (1999), and the appendix of this document.



To start with your analysis, select the ***Calendar-Time Portfolio*** option from the ***Method*** menu.

The date each asset is added to the portfolio is defined by the ***Inclusion Date***. Each asset remains in the portfolio until the ***Exclusion Date***. Both dates are defined in days/months (as defined by the user) relative to the event date (*event time*).

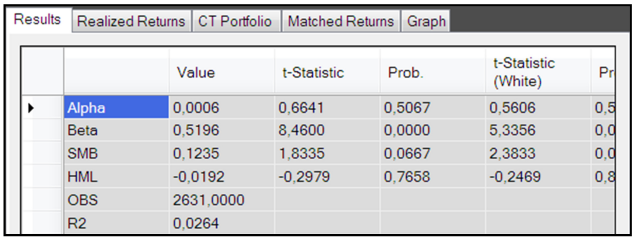
The 'Calendar-Time Portfolio' Method

You may employ the Fama-French three-factor model or a factor model that additionally contains the Carhart (1997) momentum factor to analyze returns of calendar-time portfolios from the **Normal Return Model** menu.

Furthermore, you can select an appropriate regression technique from the ***Estimation Method*** menu.

By default, Event Study Metric forms equal weighted portfolios. You might select the ***Use Weights*** option to form value weighted portfolios.

Once all selections have been made, you can execute the event study analysis by clicking on the ***Run*** button. Depending on the sample size the execution can take up to several minutes. The window might freeze while the program is in execution mode, but will be accessible after all calculations have been made.



	Value	t-Statistic	Prob.	t-Statistic (White)	Pr
Alpha	0,0006	0,6641	0,5067	0,5606	0,5
Beta	0,5196	8,4600	0,0000	5,3356	0,0
SMB	0,1235	1,8335	0,0667	2,3833	0,0
HML	-0,0192	-0,2979	0,7658	-0,2469	0,8
OBS	2631,0000				
R2	0,0264				

The regression results, intermediate calculation, and sorting steps are shown in the ***Results*** section.

The ‘Calendar-Time Portfolio’ Method

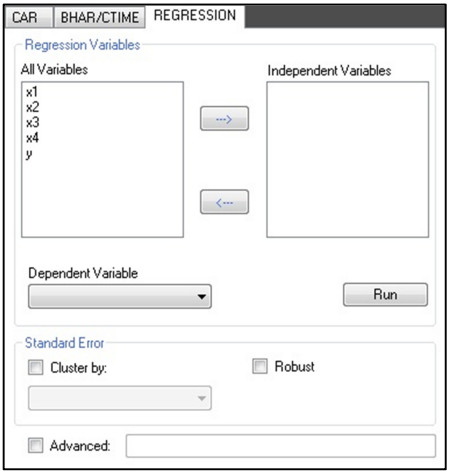
The ***Print*** feature from the ***File*** menu provides a simple way to print a summary report containing a table of summary statistics and a graph showing buy-and-hold abnormal returns over the event window.

To use the results in any other program you can simply copy & paste the data from any arbitrary spreadsheet or use the ***Export*** feature from the ***File*** menu.

The 'Regression' Analysis

The ***Regression Section*** allows you to conduct cross-sectional regression analyses of abnormal returns subsequent to an event study. Furthermore, this section can be used as a stand-alone statistic program in order to conduct an arbitrary ordinary least squares (OLS) or logistic regression. In addition, summary statistics or graphical illustrations of your data are available within this section.

The ***Regression Menu*** is a user interface, which allows you to conduct an ***OLS*** regression and edit your data with just a few clicks.



The ***Advanced Mode***, which can be activated by selecting the ***Advanced*** option, allows to conduct an **OLS** estimation complemented by distinct conditions. Furthermore, the following operations are available in in this mode: ***Logistic*** regression, ***Plotting*** variables, ***Summarize*** and ***Edit*** your data.

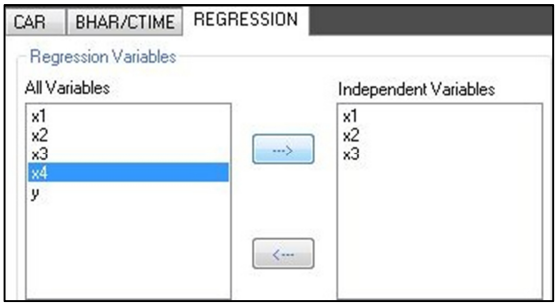
Ordinary Least Squares (OLS) Regression

Description:

You are able to conduct an ordinary least squares (OLS) regression by selecting the variables for your estimation from the ***Regression Menu*** or you may use the ***ols*** command in the ***Advanced Mode***.

The ***Regression Menu*** allows a fast application of the OLS method with a few clicks:

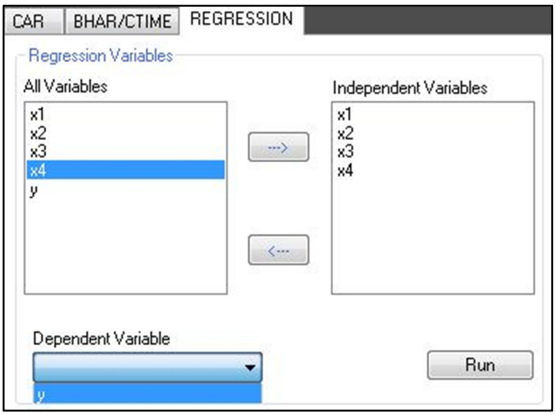
1. Select your ***Independent Variables*** by picking a variable from the *All Variables* list and clicking the ---> button.



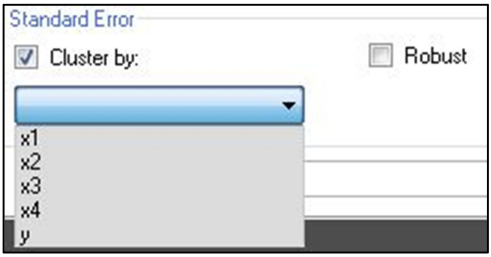
   You are able to reject your selection by picking a variable from the ***Independent Variables*** list and clicking the <--- button.

2. Select your ***Dependent Variable*** by clicking the ***Dependent Variable*** box and picking the preferred variable from the drop-down list.

Ordinary Least Squares (OLS) Regression



3. By selecting ***Cluster by*** or ***Robust***, you are able to add one of the two options to your estimation. These additional options are described below.



Robust	Reports Huber/White/Sandwich robust standard errors.
Cluster by	Reports clustered standard errors allowing for intragroup correlation. Groups are defined by $varX$. You can use any numeric or non-numeric variable.

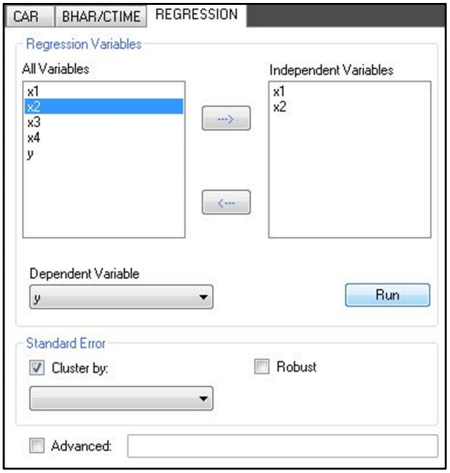
Ordinary Least Squares (OLS) Regression

4. Click the

button to conduct the regression analysis.

Ordinary Least Squares (OLS) Regression

Example 1:



Dependent Variable: y

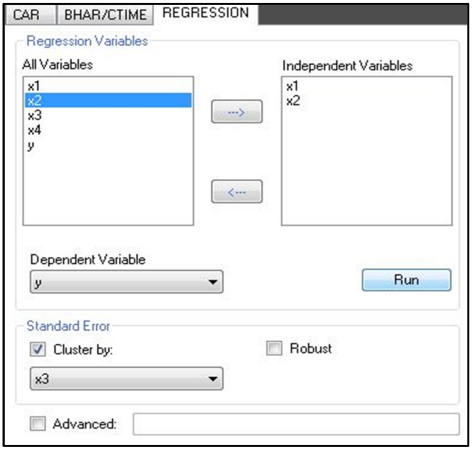
	Coef.	Std. Err.	t-Statistic	Prob.	[95% Conf.	Interval]
constant	-5,5608	0,1208	-46,0173	0,0000	-5,7986	-5,3230
x1	0,7158	0,0091	79,0089	0,0000	0,6980	0,7336
x2	7,6649	0,1186	64,6094	0,0000	7,4314	7,8983

Observations	491	F (2 , 488)	4570,6516
R^2	0,9493	Prob. F	0,0000
Adj. R^2	0,9491	Log likelih.	-372,1250
AIC	1,5280	SIC	1,5536

The table shows the regression results for the dependent variable Y and the independent variables $X1$ and $X2$.

Ordinary Least Squares (OLS) Regression

Example 2:



Dependent Variable: y
Clustered Std. Err. by x3

	Coef.	Std. Err.	t-Statistic	Prob.	[95% Conf.	Interval]
constant	-5,5608	0,0237	-234,8766	0,0000	-5,6074	-5,5142
x1	0,7158	0,0031	234,5041	0,0000	0,7098	0,7218
x2	7,6649	0,0548	139,9857	0,0000	7,5571	7,7726

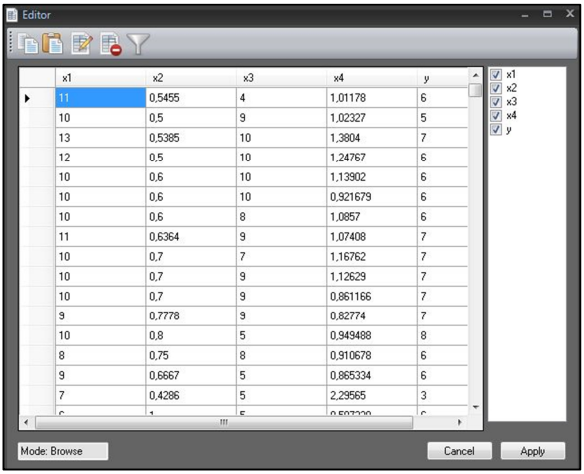
Observations	491	F (2 , 488)	4570,6516
R^2	0,9493	Prob. F	0,0000
Adj. R^2	0,9491	Log likelih.	-372,1250
AIC	1,5280	SIC	1,5536

The table shows the regression results for the dependent variable Y and the independent variables $X1$ and $X2$. $X3$ (grouping variable) assigns each observation to a specific cluster.

Editor

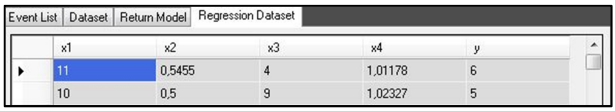
Description:

The ***Editor*** allows you to browse and to edit your data with a few clicks. In the ***Edit*** mode you are able to copy, cut and modify each observation in your dataset. In addition, the Editor allows you to delete variables and provides a variable filter.



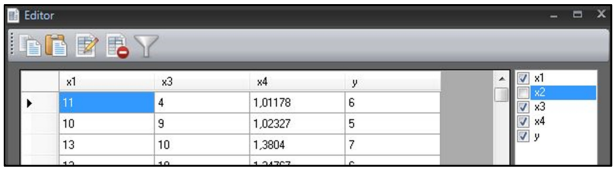
Using the Editor:

1. In order to enter the ***Editor***, double-click on any value within the ***Regression Dataset***.



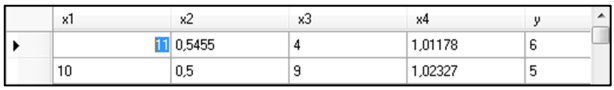
Editor

2. Removing checkmarks in the ***Variables*** list allows you to hide each variable.



3. The button allows you to enter distinct conditions in order to ***filter*** your data.

4. The button allows you to enter the ***Edit*** mode. In the Edit mode you are able to copy, paste, delete or modify the observations within your dataset.

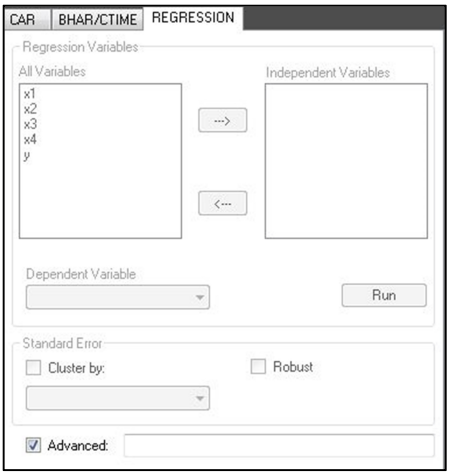


5. In order to adopt the changes, click the

button.

Advanced Mode

To enter the ***Advanced Mode*** select the ***Advanced*** option. In the ***Advanced Mode*** the output can be modified by setting distinct ***conditions***.



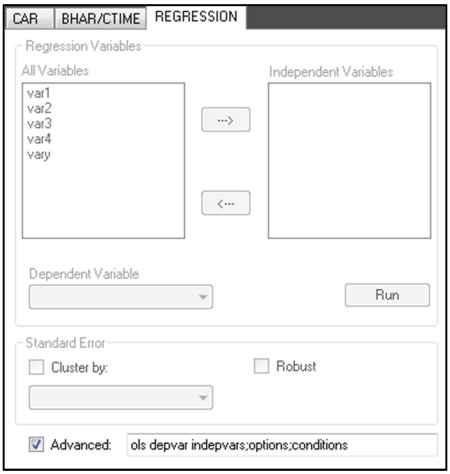
Advanced Mode: OLS Regression

Description:

You are able to conduct an ordinary least squares (OLS) regression by selecting the variables for your estimation from the ***Regression Menu*** or you may use the ***ols*** command in the ***Advanced Mode***.

Syntax:

ols *depvar indepvars*; *options*; *conditions*



Advanced Mode: OLS Regression

Options:

robust	Reports Huber/White/Sandwich robust standard errors.
cl($varX$)	Reports clustered standard errors allowing for intragroup correlation. Groups are defined by $varX$. You can use any numeric or non-numeric variable.
noconstant	Estimates the model without a constant.

Examples:

ols $varY$ $varX1$ $varX2$

OLS Regression
Dependent Variable: varY

	Coef.	Std. Err.	t-Statistic	Prob.	[95% Conf.	Interval]
constant	0.7337	0.0092	79.5658	0.0000	0.7156	0.7519
varX1	-0.0848	0.0016	-53.2833	0.0000	-0.0879	-0.0816
varX2	0.1168	0.0018	64.6094	0.0000	0.1133	0.1204

Observations	491	F (2 , 488)	2136.0799
R^2	0.8975	Prob. F	0.0000
Adj. R^2	0.8971	Log likelih.	655.0107
AIC	-2.6558	SIC	-2.6302

The table shows the regression results for the dependent variable $varY$ and the independent variables $varX1$ and $varX2$.

Advanced Mode: OLS Regression

ols $varY\ varX1\ varX2; cl(varX3)$

OLS Regression
Dependent Variable: varY
Clustered Std. Err. by varX3

	Coef.	Std. Err.	t-Statistic	Prob.	[95% Conf.	Interval]
constant	0.7337	0.0341	21.5258	0.0000	0.6667	0.8008
varX1	-0.0848	0.0044	-19.2369	0.0000	-0.0934	-0.0761
varX2	0.1168	0.0062	18.8939	0.0000	0.1046	0.1290

Observations	491	F (2 , 488)	2136.0799
R^2	0.8975	Prob. F	0.0000
Adj. R^2	0.8971	Log likelih.	655.0107
AIC	-2.6558	SIC	-2.6302

The table shows the regression results for the dependent variable $varY$ and the independent variables $varX1$ and $varX2$. $varX3$ (cluster variable) assigns each observation to a specific cluster.

ols $varY\ varX1\ varX2; cl(varX3); varX3 = 5$

OLS Regression
Dependent Variable: varY
Clustered Std. Err. by varX3

	Coef.	Std. Err.	t-Statistic	Prob.	[95% Conf.	Interval]
constant	0.7790	0.0347	22.4655	0.0000	0.7094	0.8486
varX1	-0.0913	0.0033	-27.9246	0.0000	-0.0978	-0.0847
varX2	0.1211	0.0063	19.1070	0.0000	0.1084	0.1338

Observations	53	F (2 , 50)	407.7310
R^2	0.9422	Prob. F	0.0000
Adj. R^2	0.9399	Log likelih.	99.9664
AIC	-3.6591	SIC	-3.5476

Advanced Mode: OLS Regression

The table shows the regression results for the dependent variable $varY$ and the independent variables $varX1$ and $varX2$. $varX3$ (group variable) specifies to which group each of the observations for $varY$, $varX1$ and $varX2$ belongs. $varX3 = 5$ determines that the estimation contains only the observations for group 5.

ols $varY$ $varX1$ $varX2$; $robust$

OLS Regression
Dependent Variable: varY
Robust Std. Err.

	Coef.	Std. Err.	t-Statistic	Prob.	[95% Conf.	Interval]
constant	0.7337	0.0142	51.5014	0.0000	0.7057	0.7618
varX1	-0.0848	0.0022	-38.3711	0.0000	-0.0891	-0.0804
varX2	0.1168	0.0031	37.9957	0.0000	0.1108	0.1229

Observations	491	F (2 , 488)	2136.0799
R^2	0.8975	Prob. F	0.0000
Adj. R^2	0.8971	Log likelih.	655.0107
AIC	-2.6558	SIC	-2.6302

The table shows the results for the dependent variable $varY$ as well as the independent variables $varX1$ and $varX2$ and reports Huber/White/ Sandwich robust standard errors.

Advanced Mode: Logistic Regression

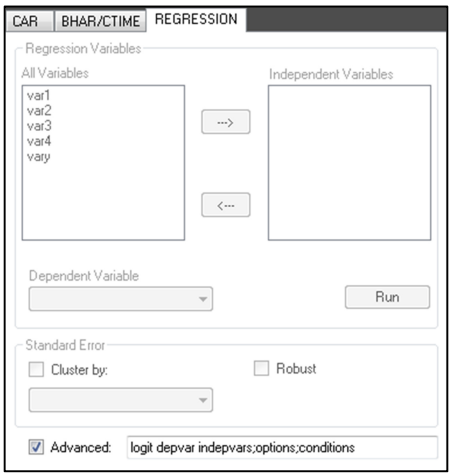
Description:

The logistic regression estimates the likelihood of an event arising. The dependent variable takes only two values (e.g. 0 and 1).

You are able to conduct the logistic regression by using the ***logit*** command. The additional ***options*** are described below.

Syntax:

logit *depvar indepvars*; *options*; *conditions*



Advanced Mode: Logistic Regression

Options:

robust	Reports Huber/White/Sandwich robust standard errors.
cl($varX$)	Reports clustered standard errors allowing for intragroup correlation. Groups are defined by $varX$. You can use any numeric or non-numeric variable.
noconstant	Estimates the model without a constant.

Examples:

logit $varY$ $varX1$ $varX2$ $varX3$

Logistic Regression
Dependent Variable: vary

	Coef.	Std. Err.	z-Statistic	Prob.	[95% Conf.	Intervall]
constant	-19.9612	4.9475	-4.0346	0.0001	-29.6582	-10.2642
varx1	1.5576	0.4120	3.7808	0.0002	0.7501	2.3650
varx2	-4.0183	1.3441	-2.9896	0.0028	-6.6527	-1.3840
varx3	3.3343	0.8043	4.1453	0.0000	1.7578	4.9108

Observations	301	Log likelih.	-19.5298
LR chi2 (3)	118.3988	Prob. chi2	0.0000
Pseudo R²	0.7519		

The table shows the regression results for the dependent variable $varY$ (with values 0 or 1) and the independent variables $varX1$, $varX2$, $varX3$.

Advanced Mode: Logistic Regression

logit $varY\ varX1\ varX2\ varX3; robust$

Logistic Regression
Dependent Variable: vary
Robust Std. Err.

	Coef.	Std. Err.	z-Statistic	Prob.	[95% Conf.	Interval]
constant	-19.9612	5.5584	-3.5912	0.0003	-30.8555	-9.0669
varx1	1.5576	0.4233	3.6795	0.0002	0.7279	2.3872
varx2	-4.0183	1.3578	-2.9595	0.0031	-6.6796	-1.3571
varx3	3.3343	0.9075	3.6743	0.0002	1.5557	5.1129

Observations	301	Log likelih.	-19.5298
Wald chi2 (3)	13.8957	Prob. chi2	0.0031
Pseudo R^2	0.7519		

The table shows the results for the dependent variable $varY$ (with values 0 or 1) as well as the independent variables $varX1$, $varX2$, $varX3$ and reports Huber/White/Sandwich robust standard errors.

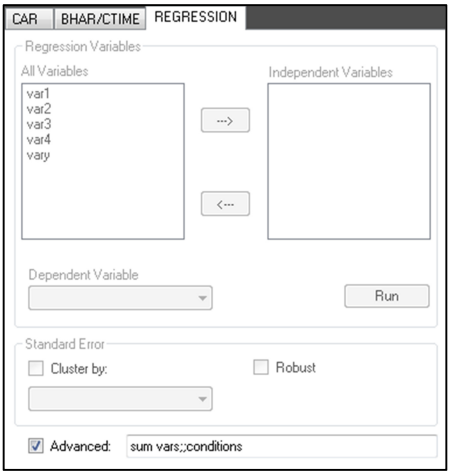
Advanced Mode: Summary Statistics

Description:

The ***mean***, ***median***, ***standard deviation***, ***minimum, maximum,*** and the ***number of observations*** for each variable are reported by using the ***sum*** command.

Syntax:

sum *vars*; ; *conditions*



Advanced Mode: Summary Statistics

Examples:

sum $var1\ var2\ var3\ var4$

Summary Statistics

	Obs.	Mean	Median	Std. Dev.	Min	Max
var1	256	1.27355	0.98360	1.51438	0.45287	22.16100
var2	256	8.85547	9.00000	2.57716	3.00000	15.00000
var3	256	5.98047	6.00000	2.58723	0.00000	13.00000
var4	256	0.67425	0.71430	0.21563	0.00000	1.00000

sum $var1\ var2;;var3 = 10$

Summary Statistics

	Obs.	Mean	Median	Std. Dev.	Min	Max
var1	7	0,94543	0,86285	0,14644	0,73737	1,16621
var2	7	11,71429	10,50000	1,70434	10,00000	14,00000

The summary statistics for $var1$ and $var2$ are reported only for the observations satisfying the condition that $var3$ equals 10.

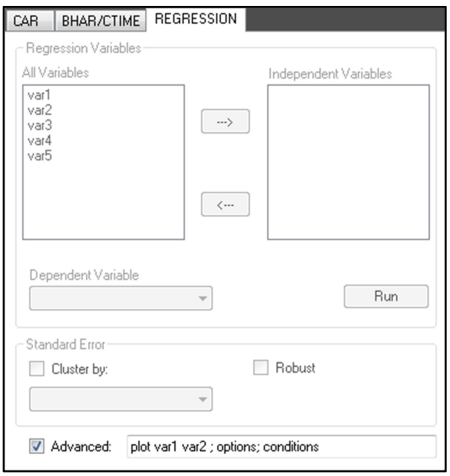
Advanced Mode: Plotting Variables

Description:

A ***plot*** visualizes the observations for a single variable or the relationship between two variables in your Dataset. Event Study Metrics offers the most common types of plots. By default, the chart is shown as a point plot. You may select your favored type by adding the ***options*** below. In addition, setting distinct conditions allows for subsample analyses.

Syntax:

plot *var1 var2 ; options; conditions*



Advanced Mode: Plotting Variables

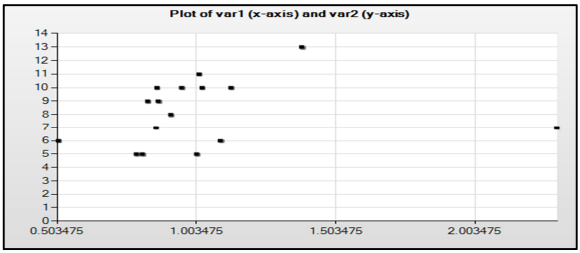
Options:

point	In the case of plotting a single variable, the chart is shown as an index plot, where the values of the variable on the y-axis are plotted against the corresponding observation numbers on the x-axis. In the case of plotting two variables, the chart shows the distribution of points, each having the corresponding values of one variable on the x-axis and of the other variable on the y-axis.
line	Shows the graph where the data points are linked by lines. This kind of plot is usually used to present the frequency of data on a number line.
bar	Shows a chart with horizontal bars. For instance, a bar graph can be used to compare the values (x-axis) of different categories (y-axis).
pie	Shows how proportions of data, shown as pie-shaped pieces, contribute to the data as a whole.

Advanced Mode: Plotting Variables

Examples:

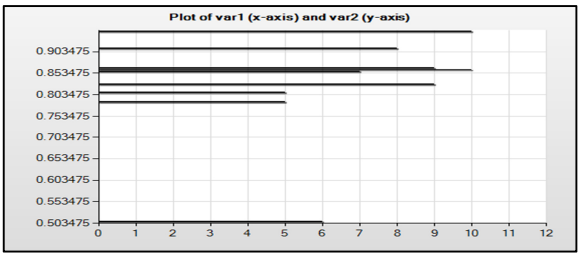
plot *var1 var2*



Scatter Plot:

var1: *values on the x-axis*
var2: *values on the y-axis*

plot *var1 var2; bar; var1 <= 1*



Bar Chart:

var1: *values on the x-axis*
var2: *values on the y-axis*

var1 <= 1: only values less than or equal to 1 for *var1* are shown.

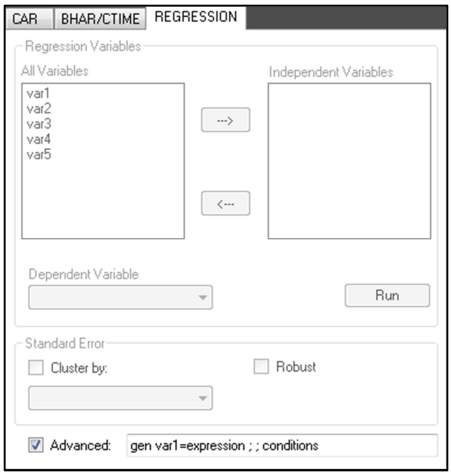
Advanced Mode: Creating Variables

Description:

To create a new variable you can use the ***gen*** command. The values of the new variable are specified by an ***expression***. Event Study Metrics offers the possibility to apply mathematical operations within ***expressions***. An overview of the provided mathematical operations is available in section ***Mathematical Expressions***. You can also define custom values. In addition, **conditions** can be used.

Syntax:

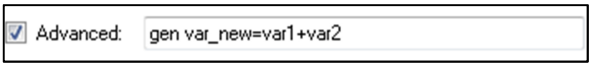
gen *var1* = *expression* ; ; *conditions*

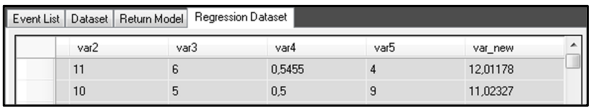


Advanced Mode: Creating Variables

Examples:

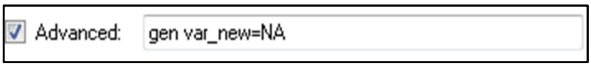
$\boldsymbol{gen}\ var_new = var1 + var2$

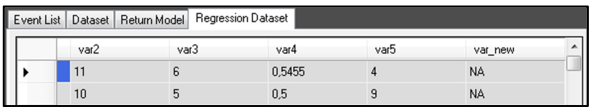




var_new is generated as the sum of $var1$ and $var2$.

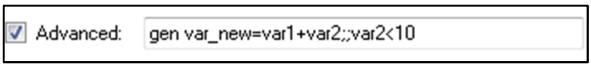
$\boldsymbol{gen}\ var_new = NA$

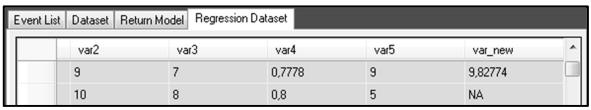




var_new contains only NA values. You are able to edit each cell in the Editor by double-clicking the value.

$\boldsymbol{gen}\ var_new = var1 + var2;;var2 < 10$





var_new is generated as the sum of $var1$ and $var2$. $var2 < 10$: values for $var2$, which are greater than or equal to 10 are not considered.

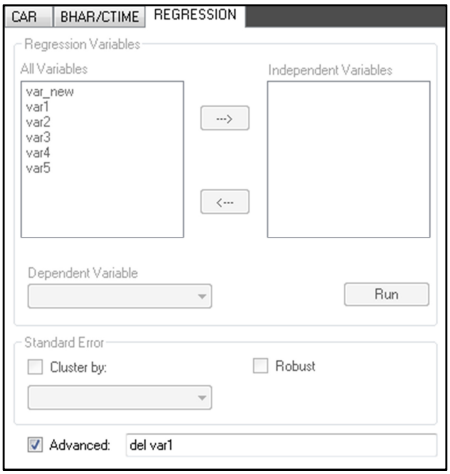
Advanced Mode: Deleting Variables

Description:

You can delete variables using the ***del*** command.

Syntax:

del *var1*



Example:

del *var_new*

var_new is deleted.

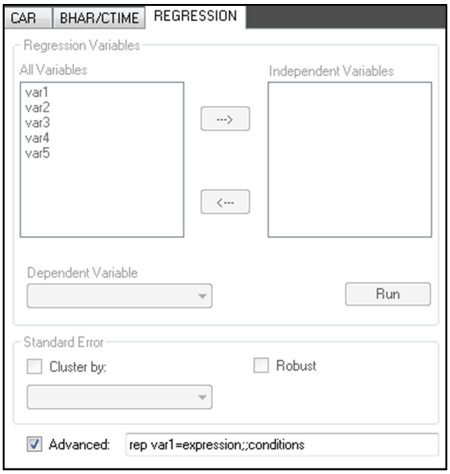
Advanced Mode: Replacing Variables

Description:

You can replace the contents of an existing variable by using the ***rep*** command. Event Study Metrics offers the possibility to apply mathematical operations within ***expressions***. An overview of the provided mathematical operations is available in section ***Mathematical Expressions***. You can also define custom values. In addition, ***conditions*** can be used.

Syntax:

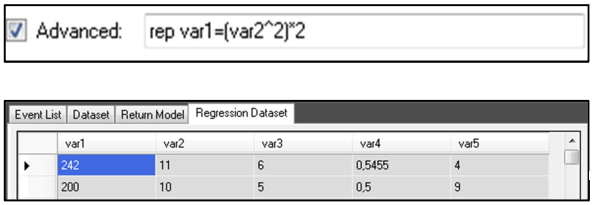
rep *var1* = *expression*; ; *conditions*



Advanced Mode: Replacing Variables

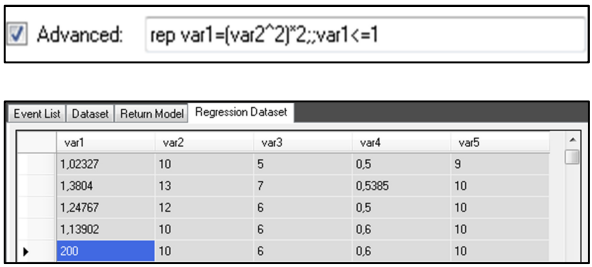
Examples:

rep $var1 = (var2\text{^}2) * 2$



The values of $var1$ are replaced by the values of $var2$ squared and multiplied by 2.

rep $var1 = (var2\text{^}2) * 2;;var1 <= 1$



The values of $var1$ which are greater than or equal to 1 are replaced by the values of $var2$ squared and multiplied by 2. The other values are retained.

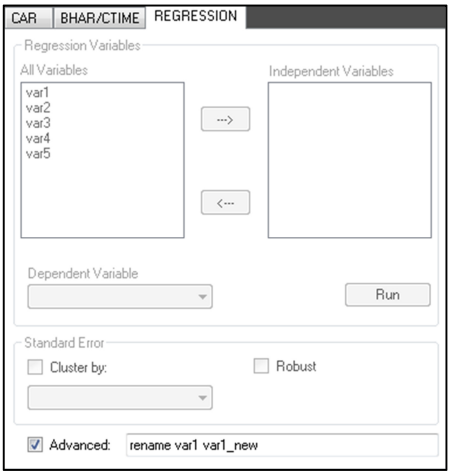
Advanced Mode: Renaming Variables

Description:

Each variable may be renamed by using the ***rename*** command.

Syntax:

rename *var1 var1_new*



Example:

rename *var1 var_new*

var1 is renamed *var_new*.

Advanced Mode: Mathematical Expressions

sin(expression)	Sine function
cos(expression)	Cosine function
tan(expression)	Tangent function
arcsin(expression)	Arcsin (inverse sine) function
arccos(expression)	Arccos (inverse cosine) function
arctan(expression)	Actan (inverse tangent) function
sqrt(expression)	Square root function
max(expression1,expression2)	Returns the maximum of expression1 and expression2
min(expression1,expression2)	Returns the minimum of expression1 and expression2
log(expression)	Logarithm to the base 10 function
ln(expression)	Natural logarithm to the base *e* function
exp(expression)	Exponential function
round(expression)	Round function
abs(expression)	Returns the absolute value of a number
pos(expression)	Transforms all values in positive values
neg(expression)	Transforms all values in negative values

Return Calculation

Event Study Metrics automatically calculates returns if your ***Dataset*** contains prices. By default, Event Study Metrics calculates simple net returns:

$$R_{i,\tau} = \frac{P_{i,\tau}}{P_{i,\tau-1}} - 1$$

If you want to apply a short-term event study based on the cumulative abnormal return measure, Event Study Metrics optionally calculates continuously compounded returns (log returns):

$$r_{i,\tau} = \ln\left(1 + R_{i,\tau}\right) = ln\left(P_{i,\tau}\right) - \ln(P_{i,\tau-1})$$

You can specify your preferred calculation method by selecting the corresponding option in the ***Return Calculation Method*** section. For further details on the properties of simple and continuously compounded return you may refer to section 1.4 of Campbell, Lo and MacKinlay (1997).

Abnormal Returns

Abnormal Returns are the crucial measure to assess the impact of an event. The general idea of this measure is to isolate the effect of the event from other general movements of the market. The abnormal return of firm i and event date τ is defined as the difference of the realized return and the expected return given the absence of the event:

$$AR_{i,\tau} = R_{i,\tau} - E\left[R_{i,\tau}\middle|\Omega_{i,\tau}\right]$$

The expected return (henceforth referred to as normal return) is unconditional on the event but conditional on a separate information set. Dependent on the definition of the information set (e.g. past asset returns) and the functional form there exist various models for the normal return. Those models are extensively discussed in the following section.

Event Study Metrics offers two different measures of aggregated abnormal returns that are commonly used in event study analyses:

Cumulating abnormal returns across time yields the cumulative abnormal return measure:

$$CAR_i(\tau_1, \tau_2) = \sum_{t=\tau_1}^{\tau_2} AR_{i,t}$$

The second measure, the buy-and-hold abnormal return, is defined as the difference between the realized buy-and-hold return and the normal buy-and-hold return:

$$BHAR_i(\tau_1, \tau_2) = \prod_{t=\tau_1}^{\tau_2}\left(1 + R_{i,t}\right) - \prod_{t=\tau_1}^{\tau_2}\left(1 + E\left[R_{i,t}\middle|\Omega_{i,t}\right]\right)$$

Abnormal Returns

Statistical test of abnormal returns are commonly based on the cross-average of each measure. For cumulative abnormal returns the cross-sectional average is:

$$\mathrm{CAAR}(\tau_1, \tau_2) = \frac{1}{\mathrm{N}} \sum_{\mathrm{i}=1}^{\mathrm{N}} CAR_i(\tau_1, \tau_2)$$

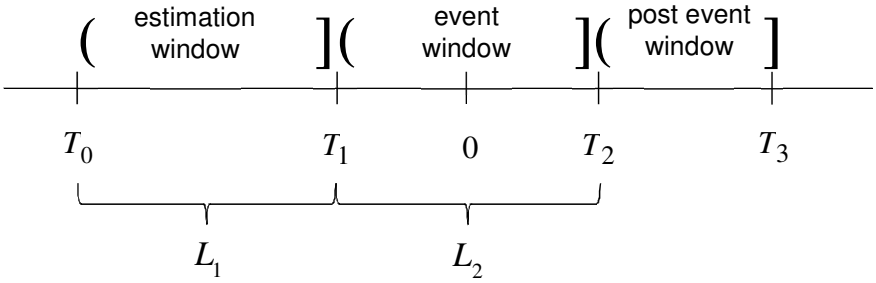
Whereas, the mean buy-and hold abnormal return is:

$$\overline{BHAR}(\tau_1, \tau_2) = \frac{1}{\mathrm{N}} \sum_{\mathrm{i}=1}^{\mathrm{N}} BHAR_i(\tau_1, \tau_2)$$

For a detailed discussion of the difference between the two measures you may consult Barber and Lyon (1997) or Ritter (1991).

Normal Return Models

A substantial feature of an event study is the choice of an appropriate normal return model. Some models contain parameters that need to be estimated (constant mean return model, market model, CAPM, and multifactor models). The time period over which parameters are estimated is commonly denoted as the estimation window. Since the normal return is the expected return in absence of the event, overlapping event and estimation windows should be avoided. Otherwise normal return model parameters are estimated from returns affected by the event. Event Study Metrics applies the common approach by restricting the estimation window to the time period prior to the event window.



By choosing the option **Skip 'near singular' events** on the ***Settings*** form all events are deleted automatically in case no regression parameters are obtained for the normal return model.

Constant Mean Return

Assume that expected asset returns can differ by company, but are constant over time. Then the constant mean return model is:

$$R_{i,\tau} = \mu_i + \xi_{i,\tau} \quad \text{with } E[\xi_{i,\tau}] = 0 \text{ and } VAR[\xi_{i,\tau}] = \sigma_{\xi_i}^2$$

The parameter μ_i is estimated by the arithmetic average of estimation-window returns:

$$\hat{\mu}_i = \frac{1}{M_i} \sum_{i=T_{0+1}}^{T_1} R_{i,\tau}$$

where M_i is the number of non-missing returns over the estimation window. Please note that $M_i \leq L_1$.

Even though the constant mean return model is simple and highly restrictive compared to other models, Brown and Warner (1980, 1985) show that results based on this model do not systematically deviated from results based on more sophisticated models. Please note that Brown and Warner (1980, 1985) only analyze short-term event studies. The selection of the benchmark models is crucial when performing a long-term event study.

Market Return

Abnormal returns are calculated by subtracting the contemporaneous return of a market index:

$$AR_{i,\tau} = R_{i,\tau} - R_{M,\tau}$$

where $R_{M,\tau}$ is the return of a market index (e.g. S&P 500).

This model is can be viewed as a restricted market model with alpha equal to zero and beta equal to one for each stock (see MacKinlay (1997)).

Since the parameters are predefined, a separate estimation window is not necessary. Thus, Event Study Metrics will ignore any settings specifying the estimation window when you select ***Market Return*** as normal return model.

However, some of the reported test statistics require an estimation window. Therefore, Event Study Metrics also allows you to apply the market return model with an estimation window. The estimation window has no influence on the normal return measure itself, but is solely used to calculate test statistics. To apply this approach you need to select the ***Market Return Est*** option from the ***Normal Return Model*** menu.

Market Model

The market model is based on the assumption of a constant and linear relation between individual asset returns and the return of a market index:

$$R_{i,\tau} = \alpha_i + \beta_i R_{M,\tau} + \varepsilon_{i,\tau} \text{ with } E[\varepsilon_{i,\tau}] = 0 \text{ and } VAR[\varepsilon_{i,\tau}] = \sigma^2_{\varepsilon_i}$$

Event Study Metrics estimates the model parameters by ordinary least squares regressions based on estimation-window observations.

Alternatively, you may choose the ***Scholes/Williams*** option from the ***Estimation Method*** menu. Instead of ordinary least squares, Event Study Metrics will then apply the method proposed by Scholes and Williams (1977) to account for non-synchronous trading. Event Study Metrics calculates the market model parameters applying the Scholes/Williams approach by:

$$\hat{\beta}_{i,SW} = \frac{\hat{\beta}_{i,lag} + \hat{\beta}_i + \hat{\beta}_{i,lead}}{1 + 2\hat{\rho}_M} \text{ and}$$

$$\hat{\alpha}_{i,SW} = \frac{1}{L_1 - 2}\left[\sum_{t=T_0+2}^{T_1-1}(R_{i,t}) - \hat{\beta}_{i,SW}\sum_{t=T_0+2}^{T_1-1}(R_{M,t})\right]$$

where $\hat{\beta}_{i,lag}$, $\hat{\beta}_i$, $\hat{\beta}_{lead}$ are the OLS estimates from the regression of $R_{M,\tau-1}$, $R_{M,\tau}$, and $R_{M,\tau+1}$ on $R_{i,\tau}$ and $\hat{\rho}_M$ is the first-order autocorrelation of $R_{M,\tau}$.

Some financial databases use adjusted betas following Blume (1975). By choosing the option **Blume Adjustment** on the ***Settings*** form betas are adjusted according to Blume (1975):

$$\hat{\beta}_{i,Blume} = 0.33 + 0.67\hat{\beta}_i$$

Market Model

Event Study Metrics offers a multi-country version of the market model. To apply this approach you need to specify a reference portfolio/index to each event. The ***Event List*** contains additional fields for each event that allow you to match a portfolio or index. Departing from the ordinary market model you can simply add the asset pricing data of your reference portfolios / indices to the ***Dataset.***

CAPM

According the capital asset pricing model, the expected excess return of asset *i* is given by:

$$\mathrm{E}\left[R_i - r_f\right] = \alpha_i + \beta_i\left[R_M - r_f\right] + \varepsilon_{\mathrm{i},\tau}$$

where r_f is the risk-free return.

Event Study Metrics estimates the model parameters of the capital asset pricing model by a time-series regression based on realized returns:

$\left(R_{i,\tau} - r_{f,\tau}\right) = \alpha_i + \beta_i\left(R_{M,\tau} - r_{f,\tau}\right) + \varepsilon_{\mathrm{i},\tau}$ with $E\left[\varepsilon_{i,\tau}\right] = 0$ and $VAR\left[\varepsilon_{i,\tau}\right] = \sigma_{\varepsilon_i}^2$

Please make sure that the time-series of risk-free returns is not annualized, but instead matches your data frequency.

Multifactor Models

Event Study Metrics offers the possibility to apply a multifactor model to measure normal returns. You can choose a multifactor model based on three or four factors. The best known approach is the three factor model developed by Fama and French (1993). Based on their empirical findings they add two additional factors to the CAPM that should increase explanatory power of the model:

$$\left(R_{i,\tau} - r_{f,\tau}\right) = \alpha_i + \beta_{i,M}\left(R_{M,\tau} - r_{f,\tau}\right) + \beta_{i,SMB}SMB_{\tau} + \beta_{i,HML}HML_{\tau} + \varepsilon_{i,\tau}$$

where SMB_{τ} stands for 'small minus big' and HML_{τ} stands for 'high minus low'. The SMB_{τ} factor should capture the excess return of small over big stocks (measured by market cap). The HML_{τ} factor should capture the excess return of stock with a high market-to-book ratio over stocks with a low market-to-book ratio. For a detailed description of the factors and the construction of the underlying portfolios you might refer to Fama and French (1993). You may obtain time-series data from Kenneth French's website.

A common extension of the three factor model is the four factor model that additionally contains the momentum factor MOM_{τ} as introduced by Carhat (1997):

$$\left(R_{i,\tau} - r_{f,\tau}\right) = \alpha_i + \beta_{i,M}\left(R_{M,\tau} - r_{f,\tau}\right) + \beta_{i,SMB}SMB_{\tau} + \beta_{i,HML}HML_{\tau}$$
$$+\beta_{i,HML}UMD_{\tau} + \varepsilon_{i,\tau}$$

where MOM_{τ} is a factor that should capture the excess return of past winning over past losing stocks. For a detailed description of the momentum factor and the construction of the underlying portfolios refer to Carhat (1997).

Matched Firms (Portfolios)

Lyon, Barber and Tsai (1999) propose the use of a portfolio matched by size and market-to-book ratio as measure of normal returns for each event. They claim that this measure is free of the new listing and rebalancing bias and propose to draw statistical evidence applying a bootstrapped version of the skewness-adjusted t-test. However, the authors cast doubt whether this approach yields well-specified test statistic in non-random samples.

To apply the matched firms (portfolio) approach you need to specify a reference firm (portfolio) to each event. The ***Event List*** contains additional fields for each event that allow you to match a firm (portfolio). Event Study Metric treats the asset pricing data of matched firms (portfolios) equal to the data of event firms. Therefore, you can simply add the asset pricing data of your matched firms to the common ***Dataset.***

Event Study Metrics will calculate abnormal returns by subtracting the contemporaneous return of the individually matched firm (portfolio):

$$AR_{i,\tau} = R_{i,\tau} - R_{MP_i,\tau}$$

where $R_{MP_i,\tau}$ is the contemporaneous return of the individually matched firm (portfolio).

Bonds (Matched Portfolios)

Bessembinder et al. (2008) discuss different methods to measure abnormal bond performance. Since some firms might have multiple bonds outstanding, they propose to conduct a bond event study on firm-level portfolios. To apply this approach you need to select the ***Bonds (Matched Portfolios)*** option from the ***Normal Return Model*** menu. Event Study Metrics will then automatically create firm-level portfolios. Each portfolio consists of all assets that share the same event date and company name based on the entries of the ***Event List***.

Event Study Metrics allows you to utilize rating equivalent reference portfolios as measure of normal returns for each event. For a detailed discussion of feasible reference portfolios you may refer to Bessembinder et al. (2008).

Event Study Metrics will calculate abnormal returns by subtracting the contemporaneous return of the individually matched firm (portfolio):

$$AR_{i,\tau} = R_{i,\tau} - R_{MP_i,\tau}$$

where $R_{MP_i,\tau}$ is the contemporaneous return of the individually matched firm (portfolio).

Some of the reported test statistics require an estimation window. Event Study Metrics allows you to conduct the aforementioned matching approach with an estimation window. The estimation window has no influence on the normal return measure itself, but is solely used to calculate test statistics. To apply this approach you need to select the ***Bonds (Matched Portfolios) Est*** option from the ***Normal Return Model*** menu.

Calendar-Time Portfolio Regressions

The Calendar-Time Portfolio method allows you to assess if event firms persistently earn abnormal returns. The general idea is to form a portfolio of event firms and to test if this portfolio exhibits any abnormal return not captured by common risk factors.

Suppose you want to asses abnormal returns over a 3 year period. For each month in calendar-time the portfolio is constructed by all firms that had an event in the three year prior to the calendar month. By default, Event Study Metrics forms equal weighted portfolio. You may select the ***Use Weights*** option to form value weighted portfolios.

You can employ the Fama-French three-factor model or a factor model that additionally contains the Carhart (1997) momentum factor to analyze returns of calendar-time portfolios.

$$\left(R_{i,\tau} - r_{f,\tau}\right) = \alpha_i + \beta_{i,M}\left(R_{M,\tau} - r_{f,\tau}\right) + \beta_{i,SMB}SMB_{\tau} + \beta_{i,HML}HML_{\tau} + \varepsilon_{i,\tau}$$

Under the null hypothesis of no abnormal return, the estimate of α_i should be not statistically different from zero.

Lyon, Barber and Tsai (1999) suggest the error term in calendar-time portfolio regressions may be heteroscedastic, since the number of securities varies over time. They propose to employ a weighted least squares regression, where the weighting factor is based on the number of assets in the portfolio. You may follow their proposal by selecting the ***WLS*** option from the ***Estimation Method*** menu. Additionally, Event Study Metrics reports t-statistics based on White (1980) robust standard errors.

Time-Series t-Test

The time-series t-test is defined as:

$$T_{time} = \frac{\mathrm{CAAR}_t}{(\tau_2 - \tau_1 + 1)^{\frac{1}{2}}\ \widehat{\sigma}_{\mathrm{AAR}_t}}$$

Under the null hypothesis, the cumulative average abnormal return is equal to zero. The statistic follows asymptotically the normal distribution. The variance estimator of this statistic is based on the time-series of abnormal returns from the estimation window:

$$\widehat{\sigma}^2_{\mathrm{AAR}_t} = \frac{1}{M - \mathrm{d}} \sum_{\mathrm{t}=Est_{min}}^{Est_{max}} \left[\mathrm{AAR}_t - \frac{1}{M} \sum_{Est_{min}}^{Est_{max}} (AAR_t) \right]^2$$

where M is the number of non-missing returns and d the degrees of freedom (e.g. market model $d = 2$).

To account for the fact that the event-window abnormal returns are an out-of-sample prediction, the standard error is adjusted by the forecast-error. In the market model, the adjustment is:

$$\sqrt{1 + \frac{1}{M} + \frac{(R_{m,\tau} - \bar{R}_{m,Est})^2}{\sum_{Est_{min}}^{Est_{max}} (R_{m,\tau} - \bar{R}_{m,Est})^2}}$$

Cross-Sectional t-Test

The cross-sectional t-test is defined as:

$$T_{cross} = \frac{\mathrm{CAAR}(\tau_1, \tau_2)}{\hat{\sigma}_{\mathrm{CAAR}(\tau_1, \tau_2)}}$$

Under the null hypothesis, the cumulative average abnormal return is equal to zero. The variance estimator of this statistic is based on the cross-section of abnormal returns.

$$\hat{\sigma}^2_{\mathrm{CAAR}(\tau_1, \tau_2)} = \frac{1}{\mathrm{N}(\mathrm{N} - \mathrm{d})} \sum_{\mathrm{i}=1}^{\mathrm{N}} [\mathrm{CAR_i}(\tau_1, \tau_2) - \mathrm{CAAR}(\tau_1, \tau_2)]^2$$

Brown and Warner (1980) show that the cross-sectional t-test is robust to an event-induced variance increase. However, Boehmer, Musumeci and Poulson (1991) provide evidence that their standardized cross-sectional test (requiring an estimation window) exhibits a comparable size, but is more powerful.

Standardized Residual Test

The standardized residual test, developed by Patell (1976), tests the null hypothesis that the cumulative average abnormal return is equal to zero. Under the assumption that abnormal returns are uncorrelated and variance is constant over time, each abnormal return is standardized by its estimated standard deviation:

$$SAR_{i,\tau} = \frac{AR_{i,\tau}}{S(AR_i)}$$

The standard deviation is estimated from the time-series of abnormal returns of the estimation window:

$$\hat{\sigma}^2_{AR_i} = \frac{1}{M_i - d} \sum_{t=Est_{min}}^{Est_{max}} \left(AR_{i,t}\right)^2$$

where M_i is the number of non-missing returns and d the degrees of freedom (e.g. market model $d = 2$). To account for the fact that the event-window abnormal returns are an out-of-sample prediction, the standard error is adjusted by the forecast-error:

$$S(AR_i) = \hat{\sigma}_{AR_i} \sqrt{1 + \frac{1}{M_i} + \frac{(R_{m,\tau} - \bar{R}_{m,Est})^2}{\sum_{Est_{min}}^{Est_{max}} (R_{m,\tau} - \bar{R}_{M,Est})^2}}$$

As simple abnormal returns, the standardized version can be cumulated over time:

$$CSAR_i(\tau_1, \tau_2) = \sum_{t=\tau_1}^{\tau_2} \frac{AR_{i,t}}{S(AR_i)}$$

Standardized Residual Test

Under the null hypothesis the distribution of SAR_i is a Student's t-distribution with $M_i - d$ degrees of freedom (for a further discussion see Campbell, Lo and MacKinlay (1997) pp. 160). It directly follows that the expected value of $CSAR_i$ is zero and the standard deviation is:

$$S(CSAR_i) = \sqrt{(\tau_2 - \tau_1 + 1)\frac{M_i - d}{M_i - 2d}}$$

The test statistic for the null hypothesis, that the cumulative average abnormal return is equal to zero, is:

$$T_{Patell} = \frac{1}{\sqrt{N}} \sum_{i=1}^{N} \frac{CSAR_i(\tau_1, \tau_2)}{S(CSAR_i)}$$

The standardized residual test is robust to heteroscedastic event-window abnormal returns. By standardizing abnormal returns before forming portfolios, the standardized residuals test assigns a lower weight to abnormal returns of securities with large variances than a simple time-series t-test.

Boehmer, Musumeci and Poulson (1991) show that under the absence of an event-induced variance increase, the standardized residuals test is well specified and has appropriate power. If the variance of stock returns increases around the event date, the standardized residuals test rejects the null hypothesis too often.

Standardized Cross-Sectional Test

Boehmer, Musumeci and Poulson (1991) combine the standardized residuals test with an empirical variance estimate based on the cross section of event-window abnormal returns to construct a test that is robust to event-induced variance increases of stock returns.

Initially, abnormal returns are standardized as described in the previous section. Then the cross-sectional average of $CSAR_i(\tau_1, \tau_2)$ is calculated:

$$\overline{CSAR}(\tau_1, \tau_2) = \frac{1}{N} \sum_{i=1}^{N} CSAR_i(\tau_1, \tau_2)$$

The standard deviation of $\overline{CSAR}(\tau_1, \tau_2)$ is estimated from the cross section of event-window abnormal returns:

$$S(\overline{CSAR}) = \sqrt{\frac{1}{N(N-1)} \sum_{i=1}^{N} [CSAR_i(\tau_1, \tau_2) - \overline{CSAR}(\tau_1, \tau_2)]^2}$$

The standardized cross-sectional test statistic for the null hypothesis that the cumulative average abnormal return is equal to zero is:

$$T_{Boehmer\ et\ al.} = \frac{\overline{CSAR}(\tau_1, \tau_2)}{S(\overline{CSAR})}$$

Option: Event Study Metrics allows you to use an adjusted version of the standardized cross-sectional test following Kolari and Pynnönen (2010).

Standardized Cross-Sectional Test

The adjusted standardized cross-sectional test statistic for the null hypothesis that the cumulative average abnormal return is equal to zero is:

$$T_{Boehmer\ et\ al.,adj.} = T_{Boehmer\ et\ al.} \sqrt{\frac{1-\bar{\rho}}{1+(n-1)\bar{\rho}}}$$

where $\bar{\rho}$ denotes the average cross-correlation among abnormal returns.

Corrado Rank Test

The non-parametric rank test proposed by Corrado (1985) tests the null hypothesis that the average abnormal return is equal to zero. Initially, abnormal returns are transformed into ranks. This is done asset by asset for the joint time period consisting of the estimation window and the event window:

$$K_{i,\tau} = \mathrm{rank}(\mathrm{AR_{i,\tau}})$$

Tied ranks are treated by the method of midranks (see Corrado (1985) footnote 5). Corrado and Zivney (1992) propose a uniform transformation of ranks to adjust for missing values:

$$\mathrm{U_{i,\tau}} = \frac{K_{i,\tau}}{(1 + M_i)}$$

where $\mathrm{M_i}$ is the number of non-missing returns for each asset.

The single day test statistic is defined as:

$$\mathrm{T_{Corrado}} = \frac{1}{\sqrt{\mathrm{N}}} \sum_{\mathrm{i=1}}^{\mathrm{N}} \left(\mathrm{U_{i,\tau}} - 0{,}5\right) / \mathrm{S(U)}$$

The estimated standard deviation is defined as:

$$\mathrm{S(U)} = \sqrt{\frac{1}{\mathrm{L_1 + L_2}} \sum\nolimits_{\tau} \left[\frac{1}{\sqrt{\mathrm{N_\tau}}} \sum_{\mathrm{i=1}}^{\mathrm{N_\tau}} (\mathrm{U_{i,\tau}} - 0.5)\right]^2}$$

where $\mathrm{N_t}$ is the number of non-missing returns (cross-section) at $\tau = \mathrm{t}$. A multiday version can be achieved by taking the average of single day statistics multiplied by the inverse of the square root of the period's length.

Generalized Sign Test

The generalized sign test proposed by Cowan (1992) is based on the ratio of positive cumulative abnormal returns p_0^+ over the event window. Under the null hypothesis this ratio should not systematically deviate from the ratio of positive cumulative abnormal returns over the estimation window p_{est}^+. Since the ratio of positive cumulative abnormal returns is a binominal random variable, the follow test statistic is used: $t_{GS} = \frac{p_0^+ - p_{est}^+}{\sqrt{p_{est}^+(1 - p_{est}^+)/N}}$

Under the null hypothesis that the average cumulative abnormal return is not statistically different from zero, the test statistic approximately follows a normal distribution.

Skewness-Adjusted t-Test

Buy-and-hold abnormal returns are positively skewed (e.g. Barber and Lyon (1997)). The skewness-adjusted t-test, originally developed by Johnson (1978), is a transformed version of the usual t-test to eliminate the skewness bias. The test statistic for the null hypothesis that the mean buy-and-hold abnormal return is equal to zero is:

$$T_{Skewness-Adjusted} = \sqrt{N}\left[S + \frac{1}{3}\hat{\gamma}S^2 + \frac{1}{6N}\hat{\gamma}\right]$$

where

$$S = \frac{\overline{BHAR}(\tau_1,\tau_2)}{\hat{\sigma}_{BHAR}}, \text{ and } \hat{\gamma} = \frac{\sum_{i=1}^{n}[BHAR_i(\tau_1,\tau_2) - \overline{BHAR}(\tau_1,\tau_2)]^3}{N\hat{\sigma}^3_{BHAR}}$$

Since $\sqrt{N}S$ is the usual t-statistic the estimated standard deviation is defined by:

$$\hat{\sigma}_{BHAR} = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}[BHAR_i(\tau_1,\tau_2) - \overline{BHAR}(\tau_1,\tau_2)]^2}$$

Lyon, Barber and Tsai (1999) recommend the use of a bootstrapped version of the skewness-adjusted t-test that yields well-specified test statistics. You can enable the bootstrap in the ***Bootstrap*** section of the ***Settings*** form. Additionally, you can specify the number and size of resamples. Event Study Metrics will report bootstrapped p-values and critical values for the 5% significance level (two-sided).

Error Codes

Can't create file!	This error message is generated when Event Study Metrics can't create a new file. Ensure that enough disk space is available and you have the permission to write and create files in the desired direction.
File used by another program!	This error message is generated when the folder or files within the folder are locked because they are being used by Windows or another program running in Windows. Close any program that is using the file and try again.
Can't find asset in dataset:	This error message is generated when an ID of the ***Event List*** is not contained in the ***Dataset***. Delete the event or add the related asset to your ***Dataset***.
Can't find date in dataset:	This error message is generated when the event date is not contained in the ***Dataset.*** Delete the event or shift the event date to the next trading date.
Can't find value for:	This error message is generated when a necessary datapoint is not contained in the Dataset. Delete the event or select the ***Ignore*** option from the ***Missing Value*** section.
Estimation window starts before the first entry:	This error message is generated when the ***Estimation Window*** exceeds the length of the ***Dataset***. Reduce the length of the ***Estimation Window*** or expand the length of the ***Dataset***.
Event window ends after the last entry:	This error message is generated when the ***Event Window*** exceeds the length of the ***Dataset***. Reduce the length of the ***Event Window*** or expand the length of the ***Dataset.***
Invalid date format!	This error message is generated when the date format of your raw data does not correspond to the date format of your Workfile. Change the date format of your raw data or Workfile and try again.

Error Codes

Near singular matrix:	This error message is generated when the independent variables of a regression are perfectly collinear.
No events!	This error message is generated when your ***Event List*** is empty. Add some events and try again.
No identifier is specified!	This error message is generated when no ***ID*** is specified. Add an ***ID*** to the related event and try again.
No model data!	This error message is generated when your ***Return Model*** spreadsheet is empty. Import your model data and try again.
No model selected!	This error message is generated when no ***Normal Return Model*** is selected. Select a model from the ***Normal Return Model*** menu and try again.
Not a valid date!	This error message is generated when you manually enter a value that is not a valid date. Adjust your entry.
Please select entry to edit!	This error message is generated when you click on the ***Edit*** button without selecting an event to edit. Select an event from the ***Event List*** and click on ***Edit*** again.
Date format must be dd.mm.yyyy!	This error message is generated when then date format of your raw data does not correspond to the date format of your Workfile. Change the date format of your raw data or Workfile and try again.

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